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secondly, the angle  $\theta$  that the ray was designed to have with the commonly perpendicular plane, when the above formula will prove itself, by giving us the correct bend  $\delta$  in the ray that the instrument was designed to produce. Whereupon any error on deflection in the entering ray either does or does not make a new angle  $\theta'$  with the commonly perpendicular plane, giving us, therefore, by the above formula the new value of  $\delta$ .

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THE INSUFFICIENCY OF DATA ON ENVIRONMENT  
GIVEN IN PAPERS DESCRIBING DEEP-SEA AND  
OTHER MARINE ORGANISMS

TO THE EDITOR OF SCIENCE: In examining a number of recently published papers on corals, foraminifera and other marine animals, especially for the purpose of ascertaining the temperature conditions under which the organisms live, I have been particularly impressed by the fact that very rarely are any definite data given on the temperature of the waters from which they were taken. As it is a generally known biological fact that temperature is one of the most influential factors in determining geographic distribution, it is highly important that precise information on this subject should be available. In fact, the data on the physical conditions under which an organism was collected should always be presented as fully as possible. Depth, temperature, nature of the bottom, and relations to marine currents, are important factors. As so many zoologists are engaged on the description of marine faunas, and as it is more or less habitual to give very meager data on the conditions under which the organisms described live, this appeal for more detailed information is made to the body of investigators through the columns of SCIENCE.

T. WAYLAND VAUGHAN

SCIENTIFIC BOOKS

*The Age of Mammals in Europe, Asia and North America.* By HENRY FAIRFIELD OSBORN. Illustrated. New York, The Macmillan Co. 1910.

Students of paleontology have awaited impatiently the past few years a promised work on extinct mammals by Professor Osborn. In his "Age of Mammals," as it has recently appeared, expectations have been more than realized. For more than a century, beginning with the classic researches of Cuvier, our knowledge of extinct vertebrates has been increasingly widened, and of no group so greatly as of the mammals. In North and South America, throughout Europe, in India, and more recently in Africa, discoveries have followed discoveries so rapidly that all but the expert have nearly given up in despair the attempt to follow and understand. And it is superfluous to say that in no part of the world has the progress of our knowledge been so rapid as in North America. Those famous pioneers in American paleontology, Leidy, Cope and Marsh, followed soon by Scott and Osborn, and later by Wortman, Hatcher, Matthew, Merriam, Sinclair, Gidley, Peterson, Douglass, Loomis, as well as others whose names may be omitted here without invidiousness, have contributed abundantly and meritoriously to our knowledge of the history of mammalian life in North America.

But, for some years it has been growing more and more evident that it was time that an inventory should be made of what we know. And this has now been done ably by Professor Osborn in this voluminous work of more than six hundred pages. That there is no place in the world where such a work could be written as the American Museum of New York City, with its extensive collections, and various experts in paleontology, especially Dr. Matthew, for aid and advice, vertebrate paleontologists know full well. That there is no one who could treat the subject more broadly and comprehensively than Professor Osborn will, also, be as readily admitted. Indeed there are few who are competent to criticize expertly the work as a whole, as the reviewer is painfully conscious, since he knows that he is not one of them. Vertebrate paleontology has advanced with such enormous strides within the scientific career of the present writer even, that it is no longer possible for

any one to be expert in more than one of its half dozen branches. But the writer does appreciate the merits of the work, since it will relieve him, in large part, as also many others, of the almost insurmountable difficulties he has encountered in attempting to keep abreast of the discoveries in mammalian paleontology.

In brief, the work deals with extinct faunas, rather than with the evolution of mammals, with "time and place" rather than with "descent"; as the author says, it is "a study of the sources or birthplaces of the several kinds of mammals, of their competitions, migrations, and extinctions, and of the time and places of the occurrence of these great events in the world's history." As such, after the introduction, of which more later, it deals with the faunas of each great division, and its minor subdivisions, so far as possible, of the Cenozoic, geologically, geographically, environmentally and faunistically. The author makes use of whatever available assistance is afforded by other branches of paleontology in his paleogeographic and climatic discussions, though not always with the same expertness that he shows in his more special field of research, the mammals, as for instance, the statement on page 106 that *Helagris* is the oldest known American serpent. Marsh years ago described the serpent *Coniophis* from the Lance beds, and the present writer can confirm his determination; and he also objects to calling *Champsosaurus* either aquatic or a lizard. But the few such errors that the writer has observed are trivial, and it would be supererogatory to search for others.

To give even a résumé of the work would be beyond the limits of this article. Perhaps no part, other than the introductory chapter, will be of more general interest than that dealing with the Pleistocene, and especially that with man in his faunal and time relations. The writer is one who still believes, notwithstanding the objections raised by geologists and anthropologists, that there is paleontological evidence of man's contemporaneity in North America with some, at least, of the extinct mammals, and he finds of interest the summary of such evidence.

By the aid of sections, maps and photographs every known horizon of the North American Cenozoic yielding vertebrate fossils is located and defined, and correlated, so far as possible, with the horizons of other lands. For the American deposits and faunas, and to a very large extent for those of other lands, the data of this work have been brought together from original sources, and the writer has sufficient acquaintance with the literature to perceive that very few indeed have been omitted or overlooked. The numerous figures of skeletons, and photographs of restorations chiefly from the able brush of C. R. Knight, will especially commend the work to the general reader. Many of these figures have become familiar to students within recent years in special works and in texts. They are here brought together and numerous others added.

Not the least useful part of the work to the zoologist is the summary of the classification of the Mammalia in the appendix, with a list of the known genera, their range and distribution. That it will be accepted immediately by zoologists in its entirety is hardly probable. The writer for one, as a student of the extinct reptiles, demurs at the unreserved location of the Multituberculata among the Marsupialia, notwithstanding the apparently convincing discoveries of Gidley. *Tritylodon* stands, confessedly, somewhere near the dividing line between the Reptilia and Mammalia, and the relationships between *Tritylodon* and the Multituberculata seem so clear that one can not accept the necessary conclusion that the reptiles evolved directly into marsupials. That some or all of the Multituberculata will some time be proved to be oviparous the writer firmly believes, and there are others who believe so with him. The author accepts not less than thirty-four orders of Placentals, arranged under four chief groups, the Unguiculata, Ungulata, Primates and Cetacea. We need to add but three or four more "cohorts" of equivalent rank—and the author may rest assured that some of his zealous colleagues will promptly do so—and we again have essentially the older classification under new names. There is a similar

tendency in all branches of natural history; and the writer deplores it. Is it not just as well to call these chief groups orders with as little disturbance as possible to existing plans of classification? For, after all, it seems to be merely a question of names. However, classification of organisms is an art that passes understanding, and no one knows where it will end; possibly when all the species have been raised to genera and all the genera to families, and families to orders, etc.

Perhaps the most widely useful part of the work is reserved for the conclusion of this review—the introductory chapter. In this the author brings together in a readable way the underlying principles of paleontology, with especial reference to mammals, but also widely applicable, not only to all branches of paleontology, but to all natural history as well. The philosophy of structure, correlation, range, environment, the laws of evolution as applying to mammals in general and in detail, are among the subjects treated. Not all is discussed that might have been; not all the conclusions are beyond controversy, but, withal, it is the best summary of the guiding principles of paleontological research the writer has seen.

The writer can not recommend the work as one suitable to slip into one's grip for literary recreation on a vacational outing—it is a little heavy and forbidding in places. As a work of reference for the geologist and naturalist it is indispensable; and it will be a working tool for the student of extinct mammals. Perhaps, with the publication of this work there will no longer be an excuse for the further display of the dense ignorance concerning extinct forms that characterizes the most of our text-books in zoology—at least let us hope so!

In conclusion it may be said that this inventory of extinct mammals has been well done; the way is again cleared for a further rapid expansion in our knowledge of this class of vertebrates. And the author is to be commended and congratulated on the opportunities he has aided in opening up.

S. W. WILLISTON

*Catalogue of the Nearctic Hemiptera-Heteroptera.* By NATHAN BANKS. Philadelphia, Pa., American Entomological Society. 1910.

This catalogue covers the entire group of Heteroptera for the Arctic region, and in this respect is of much greater service to the American student than the general catalogue of Kirkaldy which includes only a few of the families represented in this region. The work is rather a presentation of the existing knowledge than an attempt to rearrange the grouping or to introduce radical changes in the generally accepted nomenclature. The list covers 1,268 species and is particularly serviceable in certain families which have not been treated in recent years. Such a catalogue has been much needed, as the only work of a similar character, the list by Dr. Uhler, published over twenty years ago, is long since out of date. The paper shows some defects in proof reading, as for instance, the misspelling of *Macrovelia* and *Zicrona*, but on the whole it seems to be quite free from serious error. We can certainly share with the author the hope "that this catalogue will encourage entomologists to devote more time to this order, so that our forms will be better known to us."

HERBERT OSBORN

*The Relation between Chemical Constitution and some Physical Properties.* By SAMUEL SMILES, D.Sc., New York, Longmans, Green and Co. 1910.

The study of the relations between the chemical constitution and the physical properties of substances has interested chemists and physicists for a greater period of time than has the study of any other branch of chemistry which possesses more or less general interest at present. For this reason, the volume under review should exert a wider appeal than any which have appeared in the series of "Text-books of Physical Chemistry" edited by Sir William Ramsay, of which it forms a part. As part of a physical chemistry series it will appeal to physical and inorganic chemists, and it will also appeal to organic chemists, since as stated by Professor Smiles